

# The Role of Acculturation in Nutrition, Lifestyle, and Incidence of Type 2 Diabetes among Latinos<sup>1</sup>

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## Abstract

Latinos have become the largest ethnic minority group in the U.S. and will become 25% of the population by 2050. The purpose of this critical review is to examine the influence of acculturation on type 2 diabetes and corresponding risk factors, including 1) dietary intake, 2) physical activity patterns, 3) smoking and alcohol consumption, and 4) obesity. Among Latinos, acculturation has been associated with obesity risk, suboptimal dietary choices including lack of breast-feeding, low intake of fruits and vegetables, a higher consumption of fats and artificial drinks containing high levels of refined sugar, smoking, and alcohol consumption. In contrast, acculturation has been positively associated with physical activity and a lower likelihood of type 2 diabetes among Latinos. However, findings have been inconsistent across acculturation indicators and appear to be strongly modified by Latino subethnicity and gender. It is important to improve existing acculturation measures available. Mexican Americans have been the target group in the majority of studies. Research in this group must continue but it is important to conduct additional research with other Latino subgroups that have been left out of most of the acculturation, lifestyles, and health outcomes research. Differences between acculturation and health-related outcomes may be confounded by socio-economic status, age, and movement from urban to rural areas. Longitudinal multivariate acculturation research is essential to disentangle these relations and to develop sound behavioral change theories that adequately predict behavioral change among Latinos. J. Nutr. 137: 860–870, 2007.

## Introduction

The U.S. Census Bureau defines Hispanic or Latino as a person of Cuban, Mexican, Puerto Rican, Dominican, South or Central American, or other Spanish culture of origin regardless of race (1,2).<sup>2</sup> By the year 2050, Latinos will represent 25% of the U.S. population (3). Compared with their European American counterparts, Latinos experience considerably higher poverty rates (4) and worse health and nutrition outcomes including obesity (5,6) and type 2 diabetes (7,8). Latinos are far from being a homogeneous group with regard to poverty risk and poor nutrition and health outcomes (9). For instance, the poverty rate among Puerto Ricans and Mexicans is much greater than among Cuban Americans (3). Low birth weight and infant mortality rates are notably higher among Puerto Ricans than among Cubans and Mexicans (10). Studies conducted predominantly among Mexicans living in the U.S. have shown that age-adjusted mortality

rates among Latinos are comparable or lower than those of European Americans (11–15). Such a counterintuitive phenomenon, known as the “Hispanic Mortality Paradox,” has led researchers to hypothesize that factors specific to the Latino culture may buffer the negative influence of poverty on mortality outcomes among Latinos (16). Indeed, culture is a major determinant of lifestyles and corresponding health outcomes (17).

## Acculturation

Acculturation has been defined as “the process by which immigrants adopt the attitudes, values, customs, beliefs, and behaviors of a new culture” (18). Furthermore, the process of acculturation is generally considered to be linear and unidirectional (i.e., immigrants eventually adopting the mainstream culture) (19,20). A linear approach virtually excludes the possibility of multiculturalism and other outcomes such as *pochismo*, a mix of Anglo and Latino culture, expressed through a lingual hybrid denominated *Spanglish* (20). Although acculturation is a complex phenomenon that is difficult to quantify (21), researchers often base their measures on simple static proxy indicators such as birthplace, language use, and number of years spent in the U.S.

Various measures and scales have been used among different studies examining the influence of acculturation on diverse health behaviors and outcomes among Latinos. This may

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<sup>2</sup> For the sake of consistency, the term “Latin(a)o” will be the main term used in this article because it has been considered the most appropriate generic name for this segment of the U.S. population. However, readers should be aware that many of the studies included in our review use “Hispanic” as the functional label for data collection.

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partially explain the inconsistency across studies [and even within the same study using different acculturation indicators (22)] addressing the influence of acculturation on nutrition and other health-related outcomes [e.g., birth weight and postpartum depression (23)]. Although more multidimensional complex scales have been developed and used (21,24), these scales do not take into account the “life history” or trajectories of individuals that are so important for understanding acculturation.

The acculturation process is complex and multidirectional. For example, the process of acculturation among Latinos in the context of the U.S. mainstream European American culture can take at least 4 different distinct paths. First, Latinos may end up giving up completely their Hispanic culture and totally assimilating into the European American mainstream culture, i.e., following the “melting pot” social concept. Second, Latinos may choose to retain their Hispanic heritage at the same time that they fully integrate into the mainstream culture, i.e., becoming “integrated” or “bicultural.” Third, Latinos may choose to retain their Hispanic culture without attempting to integrate in the mainstream culture; i.e., becoming “separated” or “segregated” from society and being pushed to live in *ghetto* or *barrio* environments. Fourth, Latinos may end up losing their Hispanic ethnicity without seeking integration into the mainstream society, i.e., becoming “marginalized” or “invisible” with little sense of belonging to any culture (Fig. 1). These acculturation trajectories apply to individuals and communities, because individuals shape their communities as much as communities shape the decisions of the individuals living in them. The 4 different acculturation trajectories assume that the only option for Latinos is to acculturate into the mainstream European American culture. However, the reality is much more complex and multidirectional in a multiethnic society such as the U.S., where Hispanics have significant interactions with other ethnic and racial groups including African Americans and other black ethnic groups (e.g., West Indian), and Asians.

Most acculturation scales, or indicators used thus far with Latinos, fail to capture individuals who are bicultural. This is a major knowledge gap because individuals who can function well in both the Latino and the European American worlds are perhaps the most likely to have positive economic and health outcomes. A 2nd major conceptual limitation of most acculturation models is that they assume that the process involves all ethnic cultures acculturating into the mainstream European American culture

(25) when, in fact, the reverse is true in many regions of the country. For instance, Latinos have been in the southwest for hundreds of years. Indeed, in areas of high Latino density (e.g., the U.S. Mexican border), acculturation is expected to also occur to a great extent in the opposite direction (i.e., European Americans becoming acculturated into the Latino culture). A 3rd major limitation in the area of acculturation (as well as in nutrition and health research) among Latinos is the lack of longitudinal studies that actually take into account the life experiences of immigrants before moving to the U.S., and that control for important socioeconomic, demographic, and biocultural confounders (26).

The construct of acculturation is not only multidirectional but it is also multidimensional. Its several dimensions include behaviors, attitudes, norms, and values. The level of acculturation for an individual goes well beyond language use and preference, may not be constant across dimensions, and may differ across settings (e.g., home, work, and social environments). This process can only be well understood by understanding the life trajectories and places of origin (e.g., urban or rural) of the immigrant populations being studied. As this review will show, this approach for measuring acculturation among Latinos has hardly ever been used.

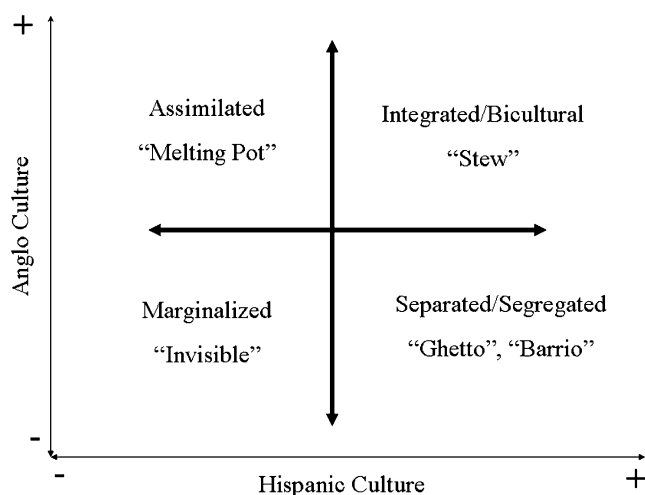
Latinos represent an ideal research model for studying the process of acculturation and assimilation into U.S. mainstream culture and its influence on nutrition and health outcomes. Two main advantages in studying acculturation in Latinos are: 1) The existence of various stages of acculturation within the same ethnic group or subgroup. For instance, whereas some Latinos have been in the U.S. for generations, others have just recently arrived and will continue to arrive in large numbers. 2) Latinos have diverse cultural backgrounds. The U.S. Census Bureau has documented the presence of Latinos from at least 20 different Latino American countries and the Caribbean. 3) Latinos are disproportionately affected by nutrition-related conditions, including the obesity and the type 2 diabetes epidemics (7,8). Therefore, the purpose of this critical review is to examine the influence of acculturation on type 2 diabetes and corresponding risk factors including 1) dietary intake, 2) physical activity patterns, 3) smoking (and alcohol consumption recognizing that the level of consumption determines whether it is a risk or a protective factor), and 4) obesity (27).

## Literature review methods

The electronic databases, PubMed (28) and ISI Web of Science (29), were used to identify original and review articles in the field of interest published between 1985 and May 2006. The following key words and different permutations were used: acculturation, Hispanic, Latinos, nutrition, diet, physical activity, alcohol, smoking, obesity, and diabetes. The search yielded 33 diet studies, 22 physical activity studies, 76 smoking studies, 96 alcohol studies, 32 obesity studies, and 27 diabetes studies. Articles were also identified through the archives of the Connecticut Center for Eliminating Health Disparities among Latinos, and by contacting key researchers in the field. Articles were considered for inclusion if they were based on quantitative data and clearly explained how acculturation and the key outcome variables were measured. The final articles were selected based on their relevance for understanding how to advance knowledge in the field. Priority was given to studies conducted since the 1990s when the country began experiencing a major growth of Latino communities, to studies that had an adequate sample size, and to recent literature reviews.

## Dietary intake

Dietary patterns have a profound influence on human health. This has led the U.S. government to revise and reissue the



**Figure 1** Multidirectional model of acculturation [adapted from Beck (23)]. Model acknowledges that Latinos can acculturate into the mainstream European American culture retaining or not retaining their cultural roots.

**TABLE 1** Dietary intake and acculturation among Latinos<sup>1</sup>

Sources	Study design	Subjects	Acculturation measure	Association with diet <sup>2</sup>
Beck (23)	Review	Mexican Americans and Puerto Rican women	ARMSA, Burnam scale, use of language, heritage, and social networking, place of birth, place of education school, acculturation score derived from 37 different variables (36, 37, 93, 94)	– BF (36, 93, 94) 0 BF (37)
Bermudez et al. (42)	Cross-sectional	Latinos, Latinas, non-Latino whites	Ethnicity	– F&V
Bermudez et al. (47)	Cross-sectional	Puerto Ricans, Dominicans, other Latinos, non-Latino whites	Modified Cuellar Scale	+ DF&S
Dixon et al. (46)	National cross-sectional survey (NHANES III)	Mexican Americans	Birthplace, primary language spoken at home.	+ DF&S
Gordon-Larsen et al. (95)	Longitudinal	White, Mexicans, Puerto Ricans, Cubans	Spoken language, birth place, time in the U.S.	– F&V
Lin et al. (44)	Cross-sectional	Puerto Ricans, Dominicans, Cubans, Mexican Americans, Central and South Americans, non-Latino whites	Language use (speaking, reading, and writing)	+ fruit & cereal pattern
Mazur et al. (49)	NHANES III	Mexican American and other youth of Latino origin	Primary language spoken by the parents	+ DF&S
Neuhouser et al. (43)	Cross-sectional	Latinos	Spoken language, thought language, ethnic self-identification, birthplace	– F&V
Satia-Abouta et al. (48)	Review	Mexican Americans, Cuban Americans, Puerto Ricans	Speaking, reading, and writing language, 5-item language scale, modified Cuellar Scale, acculturation indexes created from language, social contacts, and ethnicity pride (17, 79, 96–98)	– DF&S (17,79,97) + DF&S (98)
Unger et al. (45)	Longitudinal	Latino adolescents	AHMSA acculturation scale	+ BMI & blood pressure (96) + DF&S
Winkleby et al. (50)	Cross-sectional	Latino youth and adults, white youth and Adults	Primary language spoken at home	+ DF&S
Woodruff et al. (99)	Longitudinal	Latinos	Modified Marin scale	– DF&S

<sup>1</sup> AHMSA, Acculturation, Habits, and Interests Multicultural Scale for Adolescents; ARMSA, Acculturation Rating Scale for Mexican Americans; DF&S, dietary fat and sugar.

<sup>2</sup> +, positive association; –, negative association; 0, no association.

Dietary Guidelines for Americans every 5 y (30). These guidelines emphasize a diverse and balanced diet largely based on the consumption of whole grains and fresh fruits and vegetables (F&V),<sup>3</sup> followed by the consumption of nutritious dairy and lean animal protein foods. Moreover, the guidelines suggest adequate physical activity with moderate intake of energy, with the hope of helping to alleviate the serious obesity epidemic in the U.S. These guidelines specifically recommend limiting the consumption of refined sugar, saturated fat, trans fatty acids, and avoiding an overconsumption of total energy. Whereas some previous studies explored how dietary practices vary across ethnic and racial groups in the U.S., others examined the diet-acculturation relation among Latinos. The following sections of our review examine the influence of acculturation on dietary habits across the lifespan of Latinos (Table 1).

**Breast-feeding.** Studies in the U.S. and other industrialized nations have shown that breast-fed children are less prone to gastrointestinal and respiratory infections (31), die during infancy (32), and becoming obese (33). Further, breast-fed children in industrialized and developing nations have increased optimal visual and mental development, and women who breast-feed their children are less likely to experience breast cancer (34). Consequently, the American Academy of Pediatrics recommends that babies be breast-fed exclusively for 6 mo, followed by the introduction of healthy weaning foods and continued breast-feeding until the child is at least 1 y of age. This clearly illustrates why it is important to examine influences of acculturation on breast-feeding among Latinas.

Beck (23) recently reviewed studies examining the association between acculturation and breast-feeding among Latinas. The author reported that 3 of 4 studies conducted with Latinas (cumulative  $n = 4316$ ) documented a negative association between acculturation and the likelihood of breast-feeding. The author recommends caution interpreting these results because the studies used different indicators to assess acculturation.

Place of birth appears to have a strong influence on breast-feeding incidence. Researchers using Massachusetts birth certificate data have recently shown that place of birth, regardless of ethnicity or race (white, Asian, black, or Latinos) was significantly and consistently associated with a lower likelihood of breast-feeding (35). However, it is important to note that breast-feeding behaviors vary considerably across Latino subgroups, with breast-feeding rates being substantially higher among Mexican Americans than among Puerto Ricans. Rassin et al. (36) reported that breast-feeding incidence and duration has been inversely associated with acculturation level among Mexican Americans but Anderson et al. (37) did not find this association among Puerto Rican women living in the Continental U.S. This finding is likely to be explained by the breast-feeding cultures in the countries or territories from which Latinas emigrated. For instance, whereas over 90% of women in Mexico choose to breast-feed, only <50% of Puerto Rican women living in the island choose to do so. Interestingly, until recently breast-feeding in Puerto Rico was subject to indecent exposure laws (37). Current research provides a reason for optimism as our group has shown that culturally competent peer counseling programs that reach out to women in both the clinical and community setting are capable of significantly improving breast-feeding outcomes among Puerto Rican women living in the continental U.S. (37–39).

<sup>3</sup> Abbreviations used: F&V, fruit and vegetables; FGP, Food Guide Pyramid; NHIS, National Health Interview Survey; PA, physical activity.

**Fruits and vegetables.** Whereas breast-feeding is key to the health for infants, fresh F&V are an essential component in the diets of older children, youth, and adults. This section reviews studies that examine the association between acculturation and F&V consumption among Latinos.

Sharma et al. (40,41) analyzed results from a multiethnic cohort study regarding adherence to the Food Guide Pyramid (FGP). The study collected dietary data from 215,000 participants from 5 different ethnic groups including Latinos (mostly in Los Angeles). Participants were between 45–75 y of age and were followed from 1993 to 1996. Each participant completed a mailed, self-administered, quantitative FFQ especially developed and tested to uncover ethno-dietary differences between groups. The authors compared 1) usual intake of energy, 2) FGP servings, and 3) adherence to the FGP recommendations among different ethnic groups. The results showed lowest adherence among African Americans, Hawaiians, and Latinos and highest among Japanese American females and white females. Although non-Latino whites had better overall adherence to FGP, their mean consumption was 0.87 portions of fruit and 0.31 portions of vegetables less than that of Latinos. The ethno-dietary gap was even greater and in the same direction when comparing F&V patterns among non-U.S. born Latinos (Mexico, South America, or Central America) and their non-Latino white counterparts (the intake differential was 1.35 servings for fruits and 0.95 for vegetables). When considering F&V consumption among Latinos with regard to birthplace, results showed that non-U.S. born Latinos consumed 0.96 and 1.25 more servings of F&V, respectively than their U.S.-born Latinos counterparts. Although acculturation is a complex phenomenon (21), it seems that one of its often-measured components, birthplace, has a striking influence on F&V consumption among Latinos.

Bermudez et al. (42) investigated the influence of acculturation on dietary practices in a representative sample of Latino elders (>60 y; mostly Puerto Ricans and Dominicans) living in Massachusetts. The study also included a reference group of elderly non-Latino whites. Latinos were significantly poorer than whites. Further, Latinas had a significantly higher frequency of F&V consumption (33 times/wk) compared with non-Latinas (28 times/wk) ( $P < 0.05$ ). Plasma concentration of  $\alpha$ -carotene,  $\beta$ -carotene, lutein + zeaxanthin, and lycopene were strongly and positively associated with Latino ethnicity, even after controlling for potential socio-economic, demographic, and lifestyle confounders (diet, alcohol, and cigarette smoking). Lycopene intake was significantly higher among Latinos than among non-Latino whites. Interestingly, among Latinos, lycopene was mostly derived from cooked tomato sauce (used when preparing beans and mixed rice dishes). In contrast, among whites lycopene was mostly derived from pasta dishes. These findings may provide a nutrition-related biological explanation for the lower incidence of certain chronic diseases (e.g., prostate cancer) among Latinos compared with their white counterparts. This example illustrates how particular attributes of Latinos' diets may contribute to improved health outcomes even though this group experiences significantly higher poverty rates.

Neuhauser et al. (43) conducted a cross-sectional study on a predominantly Mexican-American adult sample from Yakima Valley in the state of Washington. Participants with lower acculturation scores had a significantly higher daily intake of F&V (5.10 servings/d) than their more acculturated counterparts (4.69 servings/d) after adjusting for age, sex, income, education, and community of residence. Acculturation was measured with a 4-item scale that included 1) most often spoken language, 2) language most often used for thought, 3) ethnic self-identifica-

tion, and 4) birthplace. Interestingly, the results also showed that Latinos consumed almost one additional serving of F&V per day (4.88 servings/d) than non-Latino whites (3.91 servings/d) (43). Findings by Neuhauser et al. contrast sharply with those reported by Lin et al. (44) that were derived from a sample of elderly Puerto Ricans and Dominicans living in Massachusetts. Lin et al. showed that more acculturated individuals were more likely to have higher fruit consumption and a relatively lower consumption of starchy foods such as rice and "viandas" (traditional starchy root vegetables) than their less acculturated counterparts. Acculturation was measured based on language used (English or Spanish) for speaking, reading, and writing. Additionally, Lin et al. reported that Latinos, regardless of their level of acculturation, were significantly less likely than their white counterparts to fall into the fruit and breakfast cereal pattern and more likely to fall into the high starchy foods dietary pattern. This "rice and viandas" pattern of consumption was associated with a significantly higher BMI and waist circumference compared with the "fruits and breakfast cereals" dietary intake pattern. The opposite direction of the association between acculturation and healthier F&V dietary patterns in the Neuhauser vs. Lin studies could be explained by the age differences of the samples, the different approaches used to assess acculturation, and/or the possibility that the influence of acculturation on diet is modified by Latino subethnicity, as it was documented for breast-feeding.

**Dietary fat and sugar.** Drawing causal inferences on the influence of acculturation on dietary fat and sugar intake among Latinos is difficult, as studies have yielded inconsistent results. Whereas some studies conducted with adolescents (45), adults (46), and the elderly (47) show a positive association between acculturation and dietary fat consumption, others found an association in the opposite direction (48). Likewise, whereas some studies with Mexican Americans have shown that those born in Mexico, or those who are less acculturated, consume diets lower in fat and higher in dietary fiber, which protect against heart disease (46,49,50), other studies suggest the opposite (48). The association between acculturation and dietary fat intake may vary across Latino subgroups, insofar as Puerto Ricans are likely to consume more fat than other Latinos (51) (Table 1).

Findings on Latino consumption of sugar as a function of acculturation are more consistent. A study done among 4–6th graders showed that Mexican American children had a higher consumption of sweetened drinks than non-Latino whites (52). Himmelgreen et al. (53) documented that Puerto Rican women who have lived longer in the continental U.S. consume soft drinks and other artificial drinks more frequently than their less-acculturated counterparts. Consistent with this, Bermudez et al. (47) reported that higher-acculturated elderly Latinos consumed foods rich in simple sugars more frequently. Although the evidence consistently points in the same direction, more studies are needed that include a broader representation of Latino subgroups as well as multidimensional and multidirectional measures of acculturation.

## Physical activity

Physical inactivity is a major risk factor for poor health, including the development of obesity (54). Thus, the 2005 Dietary Guidelines for Americans include specific physical activity (PA) recommendations (30). Because of major cultural barriers and the poverty in which Latinos live (4), it is speculated that Latinos do not have adequate access to facilities conducive to recreational or leisure time PA (e.g., gyms, safe green areas) (55,56). Therefore,

they may be at risk of being quite sedentary, particularly concerning leisure time PA, and this risk may be modified by their level of acculturation. This section reviews the literature in this area (Table 2).

Crespo et al. (54) analyzed data from the Third National Health and Nutrition Examination Survey to assess the association between acculturation and self-reported leisure-time physical inactivity among Mexican American adults. Acculturation was assessed through language preference, place of birth, and years lived in the U.S. Mexican American women had a higher adjusted prevalence of leisure-time physical inactivity than men. Inactivity was lower among those who spoke only English than among those who spoke Spanish or both English and Spanish. Additionally, inactivity patterns were less likely to be found among those living longer in the U.S. after adjusting for age, sex, education, and income.

Using data from the 1991 National Health Interview Survey, and after adjusting for income, age, and level of education, Abraido-Lanza et al. (16) found that among women, but not among men, Latin(a) ethnicity was significantly associated with a lower likelihood of having recently performed exercise (OR, 95% CI: 0.72, 0.63–0.83). Consistent with this finding, acculturation (measured by nativity status, and the length of stay in the U.S.) was positively associated with the likelihood of having recently performed exercise among Latinas (OR, 95% CI: 2.63, 1.92–3.60) but not among Latinos. Respondents were considered to have performed exercise recently if they engaged in  $\geq 11$  types of sports activities during the 2 wk preceding the survey.

Evenson et al. (57) examined the association between PA and acculturation among 1st generation Latinas in North Carolina. Participants had a median age of 30 y and  $\sim 60\%$  were born in Mexico. Nonoccupational PA was defined as meeting the recommendations for moderate or vigorous activity, or as not meeting the recommendations (i.e., inactive or insufficiently active). Among participants, 42% reported insufficient activity and 21% reported no moderate or vigorous activity. Thus, 37% met either the moderate or the vigorous PA recommendation, with only 7.4% meeting both recommendations. Consistent with previous studies (16,56), Latinas with lower English language acculturation (i.e., having a summative score of  $< 6$  of 20 possible points) were less likely to be physically active than their counterparts with more English language acculturation. Likewise, Latinas who arrived in the U.S. at a younger age were more likely to be physically active. In contrast, the length of residence in the U.S., another indicator of acculturation, was not associated with PA. However, the combination of length of residence and acculturation predicted that women who had lived for  $> 3$  y in the

U.S. and had a higher English language acculturation score were  $\sim 2$  times more likely to engage in PA than those with less years in the U.S. and with lower English language acculturation scores. In this study, there were no significant associations between acculturation indicators and the level of occupational PA among employed Latinas.

Another recent study by Fitzgerald et al. (27) examined the association between both socioeconomic status and acculturation with lifestyle risk factors (including PA) for cardiovascular disease and diabetes. The authors examined a sample of 200 low-income Puerto Rican women living in Hartford, CT. Acculturation was assessed by measuring English language preference and proficiency. In agreement with previous studies (16,56,57) the results showed a positive association between PA and acculturation.

Previous studies on acculturation and PA among Latino(a)s have not measured, in detail, different types of PA (e.g., work, house, sports/leisure). Fortunately, a recent study conducted in the 4-corner states of Arizona, Colorado, New Mexico, and Utah shed new light on this issue (58). Subjects included in the analyses ( $n = 2039$ ) were the controls in the 4-corner study of breast cancer. Respondents were classified as either Latino or non-Latino white. An adapted version of the Cross-Cultural Activity Participation Study questionnaire was used to assess occupational, home, and leisure/sports PA. The referent period was 1 y preceding the survey. In addition, women were asked to report the amount of moderate and intense PA performed at 15, 30, and 50 y of age. A variable representing lifetime PA was generated by computing the mean of the activity MET scores reported during the referent period as well as at each age point. Acculturation was assessed using Spanish/English written and oral fluency. The values ranged from 1–5 and the mean of the 2 was computed to classify subjects as having either a high or a low level of acculturation. Although the overall proportion of women engaging in leisure time PA at least 5 times/wk for a minimum of 30 min/session was low, Latinos were significantly less likely than whites to do so (25 vs. 35%,  $P < 0.01$ ). Among Latinos, 13.6% of those with a low level of acculturation met the recommended amount of leisure time PA followed by 26.2% with an intermediate level and 28.4% of those with a high level of acculturation ( $P < 0.01$  for acculturation trend). Similar findings were documented with regard to lack of leisure activities, including sports. Latinas were significantly more likely (8.1%) than whites (4.2%) to perform occupational activities defined as at least a mean of 300 min/wk of vigorous job or volunteering tasks ( $P < 0.01$ ). Less acculturated Latinas were more likely (9.8%) than those with intermediate (8.6%) or high levels of acculturation (7.1%) to perform occupational activity ( $P < 0.01$ ). Latinas were also more likely

**TABLE 2** Physical activity and acculturation among Latinas

Sources	Study design	Subjects	Acculturation measure	Association with PA <sup>1</sup>
Abraido-Lanza et al. (16)	1991 NHIS	Latinos, non-Latino whites	Nativity, time in the U.S.	+
Cantero et al. (100)	Cross-sectional	Latinas	Spoken language, time in the U.S.	–
Crespo et al. (55)	NHANES III	White, Mexican Americans	Birth place, language spoken at home.	+
Crespo et al. (56)	NHANES III	Mexican-American adults, males and females	Language preference, birth place, time in the U.S.	+
Evenson et al. (57)	Cross-sectional	Latinas	Spoken language, time in the U.S., age at arrival in the U.S.	+
Fitzgerald et al. (27)	Cross-sectional	Puerto Rican females	English language preference and proficiency.	+
Gordon-Larsen et al. (95)	Longitudinal	White, Mexicans, Puerto Ricans, Cubans	Spoken language, birth place, time in the U.S.	–
Slattery et al. (58)	Retrospective	Latino females, non-Latino white females	Written and oral language fluency	+
Unger et al. (45)	Longitudinal	Latino adolescents	AHIMSA <sup>2</sup> scale	–
Ahmed et al. (101)	2000 NHIS	U.S. adult males	U.S. citizenship and race/ethnicity	+

<sup>1</sup> +, Positive association; –, negative association; 0, no association.

<sup>2</sup> Acculturation, Habits, and Interests Multicultural Scale for Adolescents.

(38.9%) than non-Latinas (29.1%) to perform housework activity defined as at least a mean of 300 min/wk of vigorous housework or yard work ( $P < 0.01$ ). Those with a high level of acculturation were more likely than those with lower levels of acculturation to perform household activity (36.7 vs. 40.4 vs. 39.7%,  $P < 0.01$ ). With regard to the achievement of vigorous activity goals, no significant differences were detected between ethnic groups or within Latinas as a function of acculturation. However, Latinas had significantly lower vigorous MET hours. Among Latinas, acculturation was positively associated with vigorous MET hours. Overall, Latinas perform less total levels of both moderate and vigorous activities than whites do. However, it is clear that they are more likely to perform moderate or vigorous activity levels concerning housework, yard work, and dependent care (i.e., nonleisure PA). Language acculturation reduced or eliminated the ethnic difference in total activity level.

## Smoking

According to the Centers for Disease Control and Prevention, between 1995 and 1999, smoking caused roughly half a million deaths and \$150 billion in annual health-related economic damage (59). The 2001 National Health Interview Survey (NHIS) reveals that, overall, Latinos have a lower prevalence of smoking than non-Latino whites (60). The percentage of Latinos who smoke was just slightly lower ( $21 \pm 1.9\%$ ) than for white males ( $25.4 \pm 1.0\%$ ) but the difference between Latinas ( $11.9 \pm 1.3\%$ ) and white females ( $22.8 \pm 0.9\%$ ) was substantial (60). This is consistent with Molina et al. (61), who concluded that the correlation between acculturation and smoking is modified by Latino subethnicity and gender.

Overall, available evidence is supportive of the findings from the 2001 NHIS (60). To this end, Bethel and Schenker (62) investigated acculturation and smoking patterns among Latina(o)s between 1985 and 2003. The authors analyzed 11 of 78 articles that satisfied the following criteria: 1) the study was written in the English language, 2) the study was done on adults, and 3) acculturation was measured using a validated scale, choice of language, and country of origin or time spent in the U.S. The results showed that the association between acculturation and smoking was modified by gender, i.e., there was a positive association between smoking and acculturation among Latinas (throughout the lifespan, ages 18–92), but not among Latinos (62).

Further, multivariate analyses conducted by Abraido-Lanza et al. (16) with the 1991 NHIS showed that Latino men (OR, 95%

CI: 0.34, 0.28–0.41) and women (OR, 95% CI: 0.52, 0.44–0.61) were significantly less likely than their white counterparts to be current smokers. However, among Latino(a)s having a high level of acculturation was a risk factor for smoking among women but not men. In this study, respondents were classified as current smokers if they had smoked at least 100 cigarettes in their entire life and were currently smoking on at least “some” days (16).

## Alcohol consumption

In the year 2000, excessive or risky drinking in the U.S. took 85,000 lives (63) and cost \$185 billion in financial damage (64). Although the Latino population has a lower prevalence of drinking (65), liver cirrhosis is twice as likely to afflict a Latino as a white person (66). Acculturation is another factor that modifies original drinking patterns in minorities, with a tendency toward convergence with overall drinking patterns found in mainstream U.S. culture (67). Further, gender modifies the association between alcohol consumption and acculturation (68). Similarly, as with cigarette smoking, the consumption of alcohol within the Latino population varies among the different subgroups (e.g., Mexican America vs. Puerto Rican) (69) and seems gender specific (70). Consistent with smoking behaviors, females appear to consume more alcohol as the level of acculturation increases (68). Findings from Abraido-Lanza et al. (16) are in agreement. They found that for both genders, Latino(a)s were less likely to have a moderate or high level of alcohol intake than whites. This relation was stronger among women (OR, 95% CI: 0.42, 0.31–0.57) than among men (OR, 95% CI: 0.75, 0.62–0.91). Among Latino(a)s in both genders, a high level of acculturation was associated with a >2-fold higher likelihood of consuming a moderate to high level of alcohol. In these multivariate analyses, moderate to high alcohol drinking was defined as having had >1 drink/d over the previous 2 wk.

## Obesity

Obesity is a major risk factor for chronic disease and is more prevalent among minority groups such as Latinos and blacks (7,8). Ethnic obesity patterns among U.S. youth are similar to those of adults (71). Recent studies suggest that the process of acculturation may play a major role in the development of obesity among Latinos (Table 3).

Popkin and Udry (71) examined a representative U.S. sample of 12,105 adolescents (grades 7–12) using data collected between

**TABLE 3** Obesity and acculturation among Latinos

Sources	Study design	Subjects	Acculturation measure	Association with obesity <sup>1</sup>
Abraido-Lanza et al. (16)	1991 NHIS	Latinos, non-Latino whites	Nativity status, time in the U.S.	+
Bermudez et al. (42)	Cross-sectional	Latino and non-Latino white females and males	Ethnicity	0
Cantero et al. (100)	Cross-sectional	Latino females	Spoken language, time in the U.S.	+
Goel et al. (72)	2000 NHIS	Whites, Latinos	Time in the U.S.	+
Gordon-Larsen et al. (95)	Longitudinal	White, Mexican, Puerto, Cuban	Spoken language, place of birth and length of stay in the U.S.	+
Himmelgreen et al. (53)	Cross-sectional	Puerto Rican females	Length of time in the U.S.	+
Lin et al. (44)	Cross-sectional	Puerto Ricans, Dominicans, Cubans, Mexican Americans, Central and South Americans, non-Latino whites	Speaking, reading, and writing language use	+
Popkin et al. (71)	Longitudinal	Whites, Mexicans, Puerto Ricans, Cubans, other Latino	Birth place among 1st, 2nd, and 3rd generation immigrants in the U.S.	+
Slattery et al. (58)	Retrospective	Latino females, non-Latino white females	Spanish/English written and oral fluency	+

<sup>1</sup> +, positive association; –, negative association; 0, no association.

1994 and 1996 and reported a higher prevalence of obesity among the 2nd and 3rd generation of Latinos. These findings suggest that acculturation is positively associated with obesity.

Goel et al. (72) recently analyzed data from the Sample Adult Module of the 2000 NHIS to examine the relation between length of residence in the U.S. and obesity among 1st-generation immigrants (i.e., foreign-born). The immigrants studied were white, black, Latino, and Asian. The sample also included their counterparts born in the U.S. For all groups combined, length of residence in the U.S. was positively associated with being overweight (BMI = 25–30 kg/m<sup>2</sup>) and obese (BMI ≥30 kg/m<sup>2</sup>). The prevalence of obesity ranged from 8% among those living in the U.S. for <1 y to 19% among those living in the U.S. for ≥15 y. The later figure was comparable to the 22% obesity rate among all U.S. born individuals. Ethnic-specific linear regression analyses showed that years of residence in the U.S. was associated with a significant increase in BMI in both genders and among all immigrant groups except for blacks. Another important finding from this study is that foreign-born Latinos were less likely to report receiving dietary (17 vs. 22%) and PA (17 vs. 24%) counseling than their Latino counterparts born in the U.S. A similar finding was detected for blacks and Asians but not for whites (i.e., among whites, place of birth did not influence the likelihood of receiving diet and exercise counseling). All analysis controlled for age, sex, education, and income.

Consistent with these findings, Himmelgreen et al. (53) found, in a sample of Puerto Rican women of reproductive age living in Hartford, CT, that length of residence in the U.S. was significantly associated with a higher BMI. These differences were even more pronounced among women born in Puerto Rico.

Based on data from the 1991 NHIS, Abraido-Lanza et al. (16) found that among women, Latinas were at higher risk than their white counterparts for being overweight or obese. There was no relation between ethnicity and overweight or obesity among men. However, in full agreement with previous studies, among Latino(a)s, a higher level of acculturation was associated with significantly higher risks of being overweight or obese, and this was true for both men (OR, 95% CI: 1.23, 1.04–1.83) and women (OR, 95% CI: 1.62, 1.23–2.13) (16). In this study, respondents were considered to have a high level of acculturation if they were born in the U.S. or if they were foreign born but lived in the country for at ≥15 y. Respondents were coded as having a low level of acculturation if they were foreign born and had lived in the U.S. for <15 y (16).

Slattery et al. (58) found, through multivariate analyses, that Latinas from the Southwest with an intermediate level of language acculturation were ~3 times more likely to be overweight or obese than those with low levels of acculturation. Furthermore, Latinas with high acculturation had a 50–80% greater chance to be overweight or obese than their low-accultured counterparts. The authors hypothesized that Latinas with a low level of acculturation retained dietary habits of their culture and thus were better protected against obesity. On the contrary, women with intermediate levels of acculturation may have

already adopted obesogenic lifestyle behaviors typical of the U.S. mainstream culture (i.e., high energy diets without compensating for adequate levels of PA). Once women become highly acculturated, it is possible that they get more involved with vigorous physical activities available to them in the U.S. (e.g., outside sports and/or gym activities) (58). This study suggests that the relation between acculturation and obesity may not be linear.

## Gestational and type 2 diabetes

In the United States, the Latino population has a 100% greater chance (11.7%) of being affected by type 2 diabetes (adjusted for age and sex) than non-Latino whites (4.8%) (8,73). Among Latinos in the U.S., Puerto Ricans have the highest prevalence of type 2 diabetes (74) and are twice as likely to be hospitalized for diabetes-related complications (75). Despite the higher diabetes prevalence, the use of diabetes-related healthcare services such as annual dilated eye examinations, glycosylated hemoglobin tests, self-monitoring blood glucose, doctor visits for diabetes, foot examinations, and attendance at diabetes self-management classes are all lower in this population than among non-Latino whites (76). Latinos also have higher rates for major diabetes risk factors such as being overweight and being physically inactive (76,77).

Studies indicate that among Latinos, low acculturation is related to healthier diets (43,46,78,79) as well as lower rates of blood pressure, non-HDL cholesterol, cigarette smoking, and type 2 diabetes (80). However, there are reports of some healthy behaviors (i.e., avoiding high-energy foods, saturated fat, and cholesterol) (81) and greater physical activity (refer to the Physical Activity section of this review) among those who are highly acculturated. Individuals who are in the transition (middle) phase of acculturation seem to have the worst health indicators and outcomes (82), including type 2 diabetes (83) and mortality (80,84). However, 2 studies imply that acculturation is inversely related to diabetes. Kieffer et al. (85) examined the association between the incidence of gestational diabetes and mothers' place of birth. The authors examined over 10 million live single births in the U.S. in the period from 1994–1996. Mothers were from 15 different ethnic groups including Mexicans, Puerto Ricans, Cubans, Central and South Americans, and non-Latino whites. The results revealed that the majority (10 of 15 ethnic groups) of mothers born outside the 50 American states were more likely to have experienced gestational diabetes than mothers born in the U.S. Among the foreign-born group, Puerto Rican, Cuban, Central and South American but not Mexican women had a higher prevalence of diabetes during pregnancy than their non-Latino white counterparts (Table 4). Mainous et al. (86) analyzed the general prevalence and control of diabetes (the authors did not report separate results for diabetes types 1 and 2) with regard to acculturation among Latinos. The authors analyzed data from the 1999–2002 NHANES. The unweighted sample included 2696 Latino adults aged ≥18. Acculturation was

**TABLE 4** Gestational and type 2 diabetes and acculturation among Latinos

Sources	Study design	Subjects	Acculturation measure	Association with diabetes <sup>1</sup>
Sundquist et al. (80)	NHANES III	Mexican American females and males	Language preference, birth place	+
Mainous et al. (86)	1999–2002 NHANES	Latinos	Language, birth place	–
Kieffer et al. (85)	Cross-sectional	Non-Hispanic white, Mexicans, Central and South Americans, Puerto Ricans, Cubans	Birth place	– /+ (depending on nationality).

<sup>1</sup> +, positive association; –, negative association; 0, no association.

measured based on language indicators and by place of birth. The results showed that Latinos with low acculturation had higher chances to be without routine health care, health insurance, and education. Consistent with findings from Kieffer et al. (85), low acculturated Latinos had a higher chance of being affected by diabetes (OR, 95% CI: 1.90, 1.02–3.54).

## Discussion

The literature on acculturation, nutrition, other lifestyles, and health outcomes among Latinos, is replete with contradictory findings. These inconsistencies can be detected not only across but also within studies. The multifactor analysis conducted by Abraido-Lanza et al. (16), using the 1991 NHIS, is one of the few studies that actually examined, in the same representative sample, the relation between a constellation of lifestyle behaviors and acculturation among Latino(a)s. The authors clearly show that, whereas acculturation is positively related to some risk factors (e.g., smoking, alcohol intake, and overweight/obesity), it is also positively related to some protective factors (e.g., exercise). Furthermore, this study also demonstrates that gender is a powerful effect modifier of some of these relations. For example, whereas acculturation was associated with a higher likelihood of smoking among women, this was not the case for men. The same pattern of results was found regarding exercise. A review by Lara et al. (87) also shows that the empirical evidence on the relation between acculturation and a constellation of health behaviors and outcomes is replete with contradictory results. Our review also indicates that there are powerful effect modifiers including gender, age, Latino subethnicity, and socio-economic status that need to be taken into account in future studies.

A major weakness in the currently available data is that there are few studies that actually address the relation between acculturation and specific risk factors among the major Latino subgroups. The vast majority of the literature on this topic is either specific to Mexican Americans or to a pool of various Latino subethnicities. The reason is that there is often not enough statistical power to draw meaningful inferences for Latino subgroups other than Mexicans (16). Our review clearly shows that the relation between acculturation and specific diseases or behavioral risk factors is not consistently found across subgroups, and in some instances the directionality may even be reversed. An interesting hypothesis is that the relation between acculturation and specific behaviors may be due to the way the behavior is performed in the country of origin prior to moving to the U.S. It is important that future studies and surveys attempt to be more inclusive with regard to the representation of diverse Latino subgroups in their samples.

Our national Healthy People 2010 initiative emphasizes the need to reduce ethnic and “racial” (skin color) health disparities (88). Most studies examining the role of acculturation on lifestyle behaviors and health outcomes among Latinos have focused on ethnicity. In contrast, few studies have examined the issue of skin color on nutrition and health outcomes among Latinos (89). This is likely to be explained, at least in part, by the difficulty in obtaining reliable “race” (skin color) data among Latinos. Because skin color makes a difference in health outcomes among Latin Americans and Latinos, it is important to further understand how to measure this variable so that we can move beyond simply examining ethnicity.

Our current measurements of the multidimensional and multidirectional acculturation construct are quite limited. Thus, it is not surprising that the available scales and measures reported in the literature yield inconsistent results across and within

studies. The acculturation construct is a complex one that we are far from fully understanding. Thus, as Hunt et al. (26) recommend, it is important to devote more effort to understanding what it is that we are trying to measure and not so much on continuing applying simplistic acculturation scales and proxy indicators that we don’t truly understand. A major challenge for future studies in this area is to conceptualize the influence of acculturation on nutrition and health independent from key confounders such as age, income, education, and movement from rural to urban areas. The latter is a key issue, as many immigrants arriving in the U.S. are coming from rural areas in their countries. Thus, it is unknown if a similar outcome would occur among immigrants if the migration was to an urban area in their home country. It is also essential to understand how family structure and cohesion, and other potential social support systems, mediates or modifies the influence of acculturation on nutrition and health outcomes. By the same token, it is important to understand whether family structure changes significantly as a function of acculturation and whether this explains why, in some instances, the positive influence of being Latino on health outcomes appears to wane as individuals live longer in the U.S. This is fully consistent with the Abraido-Lanza et al. recommendation to incorporate more acculturation theory in public health programs to improve their effectiveness (20). The research on Mexican Americans must continue, but it is important to conduct additional research with other Latino subgroups that have been left out of most of the acculturation and health outcomes research.

## Recommendations for future research

The process of acculturation among Latinos is associated with suboptimal dietary choices including lack of breast-feeding, low intake of F&V, and a higher consumption of fats and artificial drinks containing high levels of refined sugar. Similarly, acculturation has been positively associated with PA and the likelihood of obesity and type 2 diabetes among Latinos. However, findings have been inconsistent across Latino subgroups and nutrition outcomes of interest. One limitation of available data is that most studies and surveys have concentrated on Mexican Americans and not on other Latino subgroups such as Puerto Ricans, Cuban Americans, Central and South Americans. In particular, few nationally representative surveys provide enough statistical power to assess nutrition habits and trends in Latino subgroups other than Mexican Americans. This situation needs to be addressed in the near future, as the direction of the relation between acculturation and dietary habits appears to be different among different subgroups of Latinos. This is not surprising, as several studies have shown that poverty, lifestyle behaviors, and metabolic and health outcomes differ dramatically across these groups (90).

Our understanding of the relation between poverty, acculturation, nutrition, and physical inactivity among Latinos is still limited. Given the serious obesity and type 2 diabetes epidemics in the Latino community, well-designed prospective studies are needed. It is crucial that some of these studies begin before the immigrants depart from their home countries, as their original environments may have a powerful influence in shaping their lifestyle behaviors when they move to the U.S. These studies need to use objective physical activity measures and to concentrate not only on leisure time physical activity but also on occupational activities in the case of adults and in school activities in the case of children.

It is generally well recognized that dietary choices are affected by a constellation of socio-economic, demographic, knowledge, attitudinal, and psychological (e.g., depression, self-efficacy)



factors. This recognition has led to important behavioral change models (91), many of which are not fully applicable to Latinos because they were developed primarily for Caucasian populations. Among Latinos, there is no doubt that revised theories accounting for the process of acculturation need to be considered. Developing such theories and testing them with sound empirical data based on culturally valid survey instruments and/or scales is perhaps the most important challenge currently confronting researchers and public health practitioners. Indeed, this effort is needed to develop cost-effective and culturally appropriate community nutrition programs that can make a difference in the health outcomes for Latinos in the U.S. (92).

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